JU9401V1

Data Server Use Cases

Working Paper
White Paper

Working paper - Not intended for formal review or Government approval.

August 1994

Prepared Under Contract NAS5-60000

RESPONSIBLE ENGINEER

Michael Burnett /s/ 8/29/94
Michael Burnett, Staff Engineer Date
EOSDIS Core System Project

SUBMITTED BY

Stephen Fox /s/ 8/29/94
Steve Fox, SDPS Segment Manager Date
EOSDIS Core System Project

Hughes Applied Information Systems
Landover, Maryland

This page intentionally left blank.

Contents

1. Introduction

2. Data Server Use Case Scenarios

Figures

Tables

Abbreviations and Acronyms

This page intentionally left blank.

1. Introduction

1.1 Purpose

The Earth Observing System Data and Information System (EOSDIS) is a National Aeronautics and Space Administration sponsored system that will provide science data to the user community. Within the EOSDIS system are the Science Data Processing Segment's (SDPS's) Data Servers which contain the sets of data objects and services needed to support earth science. The purpose of this document is to identify and describe for science users, a set of scenarios that demonstrate how the SDPS Data Servers support processing of the science data objects and user access to the services provided by those data objects.

This paper is meant to be a supplement to the EOSDIS Core System (ECS) System Design Specification (194-207-SE1-001).

1.2 Organization

This paper is organized as follows:

Section 1 provides an introduction and brief description of this document.

Section 2 provides an overview of data server concepts and detailed information about seven specific Data Server scenarios. Each scenario contains a description of the scenario along with a reference to a similar User Modeling scenario. An example of the service call and the Earth Science Data Type (ESDT) are also referenced and the Event Trace Table and the Event Trace Diagram showing the service interactions that are used to carry out the user request are included.

Section 3 provides a list of abbreviations used in this document.

1.3 Review and Approval

This White Paper is an informal document approved at the EOSDIS Office Manager level. It does not require formal Government review or approval; however, it is submitted with the intent that review and comments will be forthcoming.

Questions regarding technical information contained within this Paper should be addressed to the following ECS contact:

- ECS Contact: Michael Burnett
  ECS-DADS
  (301)-925-0636
  mburnett@eos.hitc.com

Questions concerning the distribution or control of this document should be addressed to:

Data Management Office
The ECS Project Office
Hughes Applied Information Systems
1616A McCormick Drive
Landover, Maryland 20785

2. Data Server Use Case Scenarios

This section provides an overview of some of the concepts that are fundamental to the design of SDPS Data Servers. This is provided in order to assist in the understanding of the material that is presented in support of the use case scenarios.

The first basic concept is to understand what a data server is. A data server is the ECS component that reliably stores, monitors, and maintains data objects and provides access to those data objects and the services available on them. From the implementation perspective a data server is the software, hardware, operations and data that support a set of data objects and mediates access to them. The ECS system will define a number of individual data servers, each responsible for a specified set of data objects. Logically, data servers may be viewed as the interface to a set of data objects and the services of those objects. Based on the client/server model, data servers provide their services to "clients". Clients include workstation software (invoked by scientists), data processing software, etc.

Every data object within a data server is of a certain data type. Data types are the definition of the common properties, services, relationships to other data types and semantics that a set of data objects share. For example, one data type that will be managed by some data server will be CER02, a CERES level 2 data product, named "ES-8 ERBE-Like Product". There will be many individual CER02 data objects, each with its own unique properties and identity. But each and every one of these data objects is of the data type CER02.

Another basic data server concept is that of collections. A collection of data objects is simply the mechanism by which one or more data objects can be managed as a single entity. A collection of data objects may also be considered to be a data object itself. An example of this is the collection of all CER02 data objects within a data server. The data server uses a collection to manage the many individual CER02 data objects as a single entity. Like all data objects, collections provide a set of services available to users. Simple examples of the services that the CER02 collection provides are adding to the collection and searching the collection. All of the data objects that are managed by data servers are grouped into collections. Indeed, data servers themselves are viewed as logical collections of data objects. The collection that the data server represents may be a collection of other collections, as collections are data objects themselves. An example of this might be a data server that manages all CERES data. That data server might be viewed as the collection of all CERES data. That collection of CERES data might be comprised of a collection of CER01 data, a collection of CER02 data, a collection of CER03 data, etc. Each of those collections would be able to manage all of their data objects as a single entity. These examples are meant to be hypothetical and are only intended to illustrate basic concepts. In no way should it be inferred that these example data servers or collections are specifically intended for implementation.

Given the powerful concept of collections of data objects, we can apply this concept to solve a number of data server design issues. The first of these is inventory. Indeed we can view the inventory of a particular data server as a collection of inventory data objects. This might be

implemented as a set of records in a RDBMS or set of metadata objects in an OODBMS. However, from the top level design view, these inventories are still collections of data objects.

Another usage of this concept of collections is to manage the results of a service request as a single entity. The results of many services, particularly search and query services, will be comprised of multiple data objects. We use a collection called the result set for this purpose. It should be noted that a given result set may contain only one data object, or may be a null set.

The last primary use of the collection concept is that of the working collection. A working collection is the client's representation of a subset of data objects in the data server. The working collection allows the client to transform the working collection and the objects within it, with no impact to the "baseline" objects. The working collection also allows the client to interface to a smaller set of the contents of the data server. This supports an iterative set of service requests without having to reconstruct the results set from scratch with each iteration. This has specific value in the case of iterative searches or queries. A user might first submit a query that results in limiting the hundreds of thousands of objects down to a thousand. Then a second query might limit that set of a thousand to dozens. The refining of the set to dozens will be much faster from the working collection of the thousand than it would be from the original collection of data server holdings.

The last basic concept relevant to data server discussions is that of sessions. Sessions are the basic mechanism used to support interactions between a service provider and its clients. In our context, sessions will provide a consistent mechanism to manage all service requests between a client and the data server. The design of the objects that will support sessions will be further defined through the Preliminary Design process. In this section we will present the role and responsibilities of the session objects, with particular focus on how sessions relate to access to data objects and data object services of data servers.

A session is established by a data server in order to fulfill a client's request for access to a data object's service. The object service request will be managed within the session. The client's request will include specification of the protocol, format and location of the result set. The session will be the control mechanism by which that request is fulfilled. When the data object service is complete, the result set will be made available to the client. The session will also establish the session's working collection. This is generally established as the most current results set. The SDS section 4.5.1.3.2.5, ECS Client Support Services, provides a detailed description of the client's perspective on sessions. From the data server's perspective the sessions provide a way of managing all the current client interaction with it's data objects. The SDS section 4.5.4.3.1, Service Class - Data Server, provides a description of the provider perspective on sessions.

From the client's perspective the real value of sessions are two-fold: A way to interactively query and request services of data objects and a technique of saving and managing long term requests or series of requests. With a session as the mechanism of interaction between the client and the data server, the client has the ability to interactively query the data server, in terms of the session's working collection. A session will maintain the current result set as the working collection (most likely as a set of universal references). Refer to the SDS for details about universal references. The client's initial service request will result in the definition of this results

set. Using client services provided via the SDPS Client Subsystem, the client may view that results set. The client may then decide to request a subsequent service on the results set, (for example, a further refining query) which will be fulfilled within the same session. Through the services provided by the Client subsystem, the session objects, the results set collection and the data objects themselves, the client has tremendous flexibility to interactively modify their view into the data server and to transform specific data objects.

Sessions may be in one of several states. Included as part of the session are services to change the state of a session. The client will have a control to terminate a session and to suspend a session. When a client terminates a session, they request that all current service processing cease, all resources required be released and that the current working collection will be deleted. When the client suspends a session, all processing will cease and resources will be released, but the data server will retain the context and all relative information, including the current working collection. The client may choose to suspend a session for many reasons. Perhaps the client wants to suspend the processing of a large results set until he/she has a chance to examine more closely a few of the results. Suspending sessions might also be useful to retain a context to the data server through time, although the client will be inactive, for example going on vacation. The client can suspend the session, then request that it be resumed at a future time. There are trade-offs to be examined through the design process pertaining to the responsibility of a data server maintaining sessions over extended periods of time.

For more details on sessions, their interfaces and their design, please reference the ECS SDS.

The following sections contain seven scenarios which show how the system responds to certain client requests based on the services it offers. This diversified set of scenarios was selected to represent, demonstrate, and validate how representative services are invoked to satisfy client requests. In no way are these scenarios intended to imply the complete set of services available to the user community.

The scenarios that are included are:

2.1 Searching Inventory for CERES Instrument Data

2.1.1 Description

In this example, let us assume it is now September, 1999. A scientist is interested in surveying sea ice measurements taken with the Clouds and Earth's Radiant Energy System (CERES)

instrument. Through the support of the Interoperability and Data Management Subsystems the scientist has previously determined that the Earth Radiative Process data server at LaRC is the proper provider for the CERES data (CER02, ES-8 ERBE-like Product) that they are looking for. The scientist has an icon on his Scientist Desktop representing the inventory search service for this data server. As the scientist initiates this interface to the inventory search service, the interface itself will be updated by the service itself with current parameters, valid values, etc. The Client subsystem will form a search request using this service interface that will be sent to this data server. This search request will specify that the client is interested in CER02 data. The criteria for this search will be the data objects for the summer months of the past 6.5 years above 60 degrees N. in latitude. The client software has specified that the results are to be packaged as a sorted list of descriptions and universal references. The request will be verified by the Data Server and a session will be established with the client. Upon establishing the session, a processing thread will be created to manage the requests within the session. The initial search on CER02Inventory will be formed with the client's search criteria. The CER02Inventory returns results to the session that are saved as a working collection. The session will communicate the results set, in this case a collection of CER02 data, to the client.

Upon receipt of the result set the desktop will present this collection to the client. Upon scrolling through the result set the client realizes that there were too many hits and decides to refine the spatial domain to 70 degrees N. in latitude, as there will be far less area and a much greater probability of sea ice. Through the desktop the client forms another search request to be executed upon the current working collection. This request specifies that only products within the newly redefined spatial domain are to be retained. The desktop will give the search request directly to the session, which will give it to the working collection. Upon completion the working collection has been changed to reflect the proper set of data objects. That results set is then communicated to the scientist, via the desktop, again as a sorted list.

2.1.2 User Model Relevant Scenario/Step

Scenario #11c/ Step 6 - Radiative Flux Scenario

2.1.3 Service Call

CER02Inventory::/Search/Search(collection, query)

2.1.4 Earth Science Data Type

CER02 Level 2 ES-8 ERBE-like Product

2.1.5 Data Event Trace Table and Diagram

Table 2.1-1. Searching Inventory for CERES Instrument Data Event Trace Table (1 of 2)

Step	From	To	Service	Description
1	Science User	Desktop	open_desktop_object	Re-establish the scientists connection to the data server inventory search service. In re-establishing the search interface, the search interface will be re-configured with current parameters, valid values, etc.
2	Desktop	Data Server	search	Bind search request (Data Location: LaRC Earth Radiative Process data server, Data type:CER02Inventory, Time: >03/93, Spatial: >60N latitude).
3	Data Server	Session	initiate_session	Create a session between the client and the data server.
4	Session	Data Type (CER02Inventory)	search	Invoke the search service on the LaRC Earth Radiative Process's CERES02 Inventory. (Time: >03/93, Spatial: >60N latitude).
5	Data Type (CER02Inventory)	Results Set	create	Establish the results set, which will be a collection of CER02 inventory objects.
6	Data Type (CER02Inventory)	Results Set	add_to_collection	Add CER02 inventory objects to results set, as they match search filter criteria.
7	Data Type (CER02Inventory)	Session	provide_status	Provide updates to "hit count" (number of matching inventory objects).
8	Session	Desktop	status_update	Provide visibility of "hit count" (number of matching inventory objects) to scientist.
9	Data Type (CER02Inventory)	Session	report successful completion	
10	Session	WorkingCollection	create	Create the session's working collection from the results set.
11	Session	Desktop	deep_copy_desktop_object	Provide the search results to the scientists desktop.
12	Science User	Desktop	open_desktop_object	Scientist reviews the search results set.
13	Science User	Desktop	search_container	Scientist decides to request search service to refine results set (by default, use current working collection, spatial: > 70N latitude).
14	Desktop	Session	execute_request	Request session execute search service on working collection (spatial: > 70N latitude).

Table 2.1-1. Searching Inventory for CERES Instrument Data Event Trace Table (2 of 2)

Step	From	To	Service	Description
15	Session	WorkingCollection	search	Command to refine the current working collection - search based on new search criteria: (north of 70N degrees latitude).
16	WorkingCollection	Session	provide_status	Provide updates to "hit count" (number of matching inventory objects).
17	Session	Desktop	status_update	Provide visibility of "hit count" (number of matching inventory objects) to scientist.
18	WorkingCollection	Session	report successful completion	Return successful completion to session [1].
19	Session	Desktop	deep_copy_desktop_ object	Provide the search results to the scientists desktop.

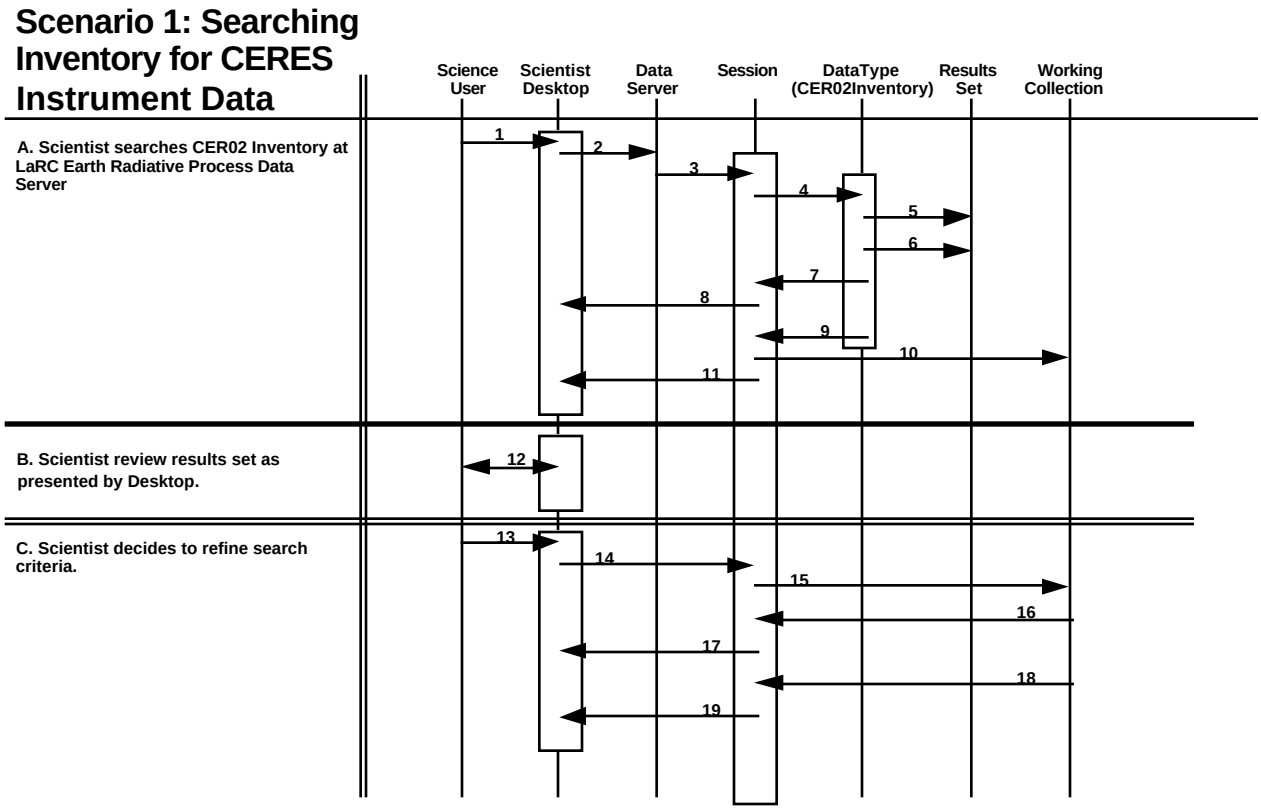

Figure 2.1.1. Searching Inventory for CERES Instrument Data Event Trace Diagram

[1]Success/Fail responses will be provided by all service invocations. For the purpose of the remainder of this paper, successful completion will be assumed and will not be specified in the event traces.

2.2 Subsetting a CERES Level 3 Data Product

2.2.1 Description

Subsetting services allow users to specify a portion of a product to be extracted for further analysis. The subsetting service is a Manipulate-type of service where users are provided with an alternative presentation of a data product that was transformed by the subsetting algorithm. The result of a subsetting service is not a new data product, but rather a different presentation of the same information. Subsetting algorithms can be either routines that are provided by ECS, provided by a DAAC, or provided by a user. All subsetting algorithms must first undergo a set of integration and test scenarios prior to being approved, integrated, and executed at a DAAC. Subsetting algorithms may either be executed within the Data Server subsystem or within the Data Processing subsystem. Standard subsetting algorithms that are based on either a spatial rectangular geographic location, a spectral band, a time parameter, or a combination thereof, are routinely performed within the Data Server subsystem. These routines are usually simple calculations applied to the structure holding the data of interest. More complex routines supplied by the DAACs or the users, that have been integrated and tested, are generally executed within the Data Processing subsystem. An example of this is a complex subsetting algorithm is one that supports a specific polygon structure on a data product.

A subsetting service does not perform any computational processing on the science data itself. The only computational processing that subsetting services may perform are on time and space values which might be parameters to the subsetting algorithm. Computation processing on any data outside of time and space is considered context-based search. The structure of the subsetted data stays the same as the original data, with only the volume of data changing. Subsetting services are performed by knowing the type and format of the data collection's computer science data structure. Subsetted data is returned to the requester and is not archived or retained by ECS.

This example will show how system users are able to request the execution of a DAAC-supplied subsetting service on the CERES Level 3 data product in order to view the resulting information on the user screen. The subsetting service that will be used is a DAAC-supplied and (I&T) approved subsetting method for the ERBE-like Science Product 4 Gridded (ES-4G) CER03 product.

This scientist is interested in performing some analysis on cloud cover data over Australia's Simpson Desert. The scientist knows that the Earth Radiative Process data server at LaRC is the proper provider for the CERES instrument data product that he is interested in. The scientist has an icon on his Scientist Desktop representing the inventory search service for this data server. As the scientist initiates this interface to the inventory search service, the interface itself will be updated by the service itself with current parameters, valid values, etc. The Client subsystem will form a search request using this service interface that will be sent to this data server. This search request will specify that the client is interested in CER03 data. The criteria for this search will be the data objects for from October, 1998 to March, 1999, that are wholly contained in a rectangle that represents Australia. The client software has specified that the results are to be packaged as a sorted list of descriptions and universal references. The request will be verified by

the Data Server and a session will be established with the client. Upon establishing the session, a processing thread will be created to manage the requests within the session. The initial search on CER03Inventory will be formed with the client's search criteria. The CER03Inventory returns results to the session that are saved as a working collection. The session will communicate the results set, in this case a collection of CER03 data descriptions and universal references, to the client. The scientist then reviews the descriptions of these CER03 data objects.

Now satisfied that these data objects meet his needs the scientist decides that he would like to look at these data objects using the general visualization application provided with his Desktop. However, since the area of his interest is really just the Simpson Desert, he realizes that he would like to minimize the amount of data actually presented to him. So he decides to see what type of subsetting services are available to him. The scientist selects the entire results set as presented to him through the Desktop and does a right-button click with his mouse. This triggers a sequence of collaboration between the objects supporting the client's session. The result of this is a scrolling list of service descriptions presented in a pop-up window. The user selects CER03_POLYGON_SUBSET from the list. Upon the selection of the CER03_POLYGON_SUBSET service the Desktop will request the interface to that service. The request for the interface will be handed to the working collection of CER03 data objects. The working collection service will configure the interface application and execute it, with the display remoted to the Scientist Desktop.

This screen is used by the scientist to enter in mandatory and optional parameters required to execute the selected algorithm. He proceeds by defining a polygon containing the Simpson Desert (spatial coverage), using a rubber-banding technique with his mouse. He also specifies that only the monthly averages of LW_Flux, SW_Flux and albedo parameters are desired. In some cases, the scientist chooses not to respond to a required parameter, thus accepting the default value. For example, he did not specify any subsampling parameters and therefore, will receive the a full resolution image, rather than a lower resolution image. When the scientist has completed using the interface to specify the subsetting parameters to be used, he will click on the presented OK button. The interface will then package the inputs specified by the user's actions, augment them with defaults and invoke the CER03_POLYGON_SUBSET service.

That service uses the processing facilities of the Data Processing subsystem. The working collection supporting the scientist's session will submit a process request to the Product Management subsystem. At this point the processing thread directly supporting the scientist becomes dormant, in that it is awaiting the completion of the Data Production Request.

Some time later the Data Processing subsystem will begin to process the request in support of the subset service. In order to do this the Data Processing Subsystem submits a request to acquire the supplied list of CER03 data objects. At this time the Data Processing subsystem becomes another client of the data server. As a data server client, the Data Processing subsystem has requested to acquire a specific set of CER03 data objects, and have them staged on a defined storage resource that the Data Processing subsystem manages. In support of fulfilling this request the data server initiates another session, (this one with the Data Processing subsystem as client), and creates a working collection for that session and requests the acquire service with the supplied parameters (format, compression, and location). The working collection will

collaborate with data distribution to perform this electronic push distribution. Once the data processing subsystem has been notified that the requested data objects are available, the subsetting algorithm will be run. Results from this algorithm will be saved in the location specified by the original data process request. Then the Data Processing Subsystem will notify the request submitter (its client), our original working collection, of the results availability.

The working collection will then have Data Distribution prepare the resultant subsetted CER03 data objects for electronic pull and notify the scientist's desktop that the data is available. At that point the desktop's visualization application will be given the object references. The image of the CER03 data objects over the Simpson Desert showing the LW, SW, and albedo averages can then be viewed and analyzed by the user.

2.2.2 Relevant Scenario/Step

Scenario #13/ Steps 7 & 12 (Review Paper about the Earth Radiation Budget [ERB])

2.2.3 Service Call

CER03 ::/Manipulate/CER03_POLYGON_SUBSET(collection, polygon_spatial_coverage,

time_temporal_coverage, parameter_1,

parameter_2, ... parameter_n)

2.2.4 Earth Science Data Type

The data representing the CER03 Level 3 ES-9, ES-4, ES-4G ERBE-Like Product is generated and permanently stored at the LaRC DAAC. Atmospheric coverage is from the surface to the top of atmosphere (TOA). The data supports global, zonal, and regional coverage. The ES-4G data product stores the same time and space averages as the ERBE-like Science Product 4 (ES-4) with the exception being the arrangement of the data. The ES-4G file presents a gridded data product with all regions for a given data parameter grouped together where ES-4 is arranged only by region. Data required to generate the CER03 data product are first held in local storage and an algorithm is executed to produce the Level 3 product and its corresponding metadata; both which are permanently archived. The CER03 data product and metadata are not required for later product production and are therefore deleted from staging.

2.2.5 Data Event Trace Table and Diagram

Table 2.2-1. Subsetting a CERES Level 3 Data Product Event Trace Table (1 of 3)

Step	From	To	Service	Description
1[2]	Science User	Desktop	open_desktop_object	Re-establish the scientists connection to the data server inventory search service.
2[2]	Desktop	Data Server	search	Bind search request (Data Location: LaRC Earth Radiative Process data server, Data type:CER03Inventory, Time: 10/98-3/99, Spatial: rectangle defining area).
3[2]	Data Server	Session	initiate_session	Create a session between the client and the data server.
4[2]	Session	Data Type (CER03Inventory)	search	Invoke the search service on the LaRC Earth Radiative Process's CERES03 Inventory. (Time: 10/98-3/99, Spatial: rectangle defining area).
5[2]	Data Type (CER03Inventory)	Results Set	create	Establish the results set, which will be a collection of CER03 inventory objects.
6[2]	Data Type (CER03Inventory)	Results Set	add_to_collection	Add CER03 inventory objects to results set, as they match search filter criteria.
7[2]	Data Type (CER03Inventory)	Session	provide_status	Provide updates to "hit count" (number of matching inventory objects).
8[2]	Session	Desktop	status_update	Provide visibility of "hit count" (number of matching inventory objects) to scientist.
9[2]	Data Type (CER03Inventory)	Session	report successful completion	
10[2]	Session	WorkingCollection	create	Create the session's working collection from the results set.
11[2]	Session	Desktop	deep_copy_desktop_object	Provide the search results to the scientists desktop.
12[2]	Science User	Desktop	open_desktop_object	Scientist reviews the search results set.
13[2]	Science User	Desktop	desktop_object_get_available_services	Scientist requests list of available services on this data type.
14[2]	Desktop	Session	execute_request	Request session executes service to return list of services.
15[2]	Session	WorkingCollection	get_service_list	Command to specify list of available services.
16[2]	WorkingCollection	Session	successful return	Provide list of available services.

[2] This step is performed in the data server's direct support of the scientist's request (as the data server's client).

Table 2.2-1. Subsetting a CERES Level 3 Data Product Event Trace Table (2 of 3)

Step	From	To	Service	Description
17[2]	Session	Desktop	copy_desktop_object	Provide visibility of list of services for data type.
18[2]	Science User	Desktop	scroll_container	Scroll through list of services.
19[2]	Science User	Desktop	desktop_object_bind_new_service	User selects CER03_POLYGON_SUBSET service.
20[2]	Desktop	Session	execute_request (CER03_POLYGON_SUBSET_INTERFACE)	Desktop requests CER03_POLYGON_SUBSET interface.
21[2]	Session	WorkingCollection	CER03_POLYGON_SUBSET_INTERFACE	Command to invoke CER03_POLYGON_SUBSET interface.
22[2]	WorkingCollection	Desktop (service interface application)	bind_import_service	Remotely display CER03_POLYGON_SUBSET interface on desktop.
23[2]	Science User	Desktop (service interface application)		User manipulates the CER03_POLYGON_SUBSET interface, defining polygon of desired information and specifying SW_Flux, SW_Flux and albedo parameters.
24[2]	Desktop (service interface application)	WorkingCollection	CER03_POLYGON_SUBSET	Interface results sent to working collection.
25[2]	WorkingCollection	Production Management	Submit_Process_Request	Request subsetting algorithm be performed on current working set of objects, with user specified criteria.
26[3]	Data Processing	Data Server	acquire	Request for staging of objects. Request is for the set of objects specified in the processing request, location is a Data Processing storage resource.
27[3]	Data Server	Session	initiate_session	Create a session between the client (Data Processing) and the data server.
28[3]	Session	WorkingCollection	create	Create the Data Processing client session's working collection from the information provided by Data Processing.

[3] This step is performed in the data server's direct support of the Data Processing subsystem request. The Data Processing subsystem's requests are indirectly supporting the scientists for the subsetting of data.

29[3]	Session	WorkingCollection	acquire	Bind request to acquire the objects specified. The request is to have the objects staged on a disk resource that the Data Production (this session's client) has specified (an electronic push).

Table 2.2-1. Subsetting a CERES Level 3 Data Product Event Trace Table (3 of 3)

Step	From	To	Service	Description
30 [3]	WorkingCollection	DataType	acquire	Request to acquire each specified data object.
31 [3]	DataType	DataStorage (archive)	retrieve	Retrieve data objects from archive, placing them into the "push" staging resource.
32 [3]	WorkingCollection	DataDistribution	prepare_push_data	Complete staging of needed objects for data processing.
33 [3]	DataDistribution	DataProcessing		Data Availability Notice sent to Data Processing.
34 [3]	DataServer	Session	terminate	Data Server terminates session, which cleans up resources used and removes it as an active session.
35	DataProcessing		executes algorithm	Actual subsetting is performed within the Data Processing Subsystem.
36 [2]	DataProcessing	WorkingCollection	report successful completion	Data Processing completes subsetting, results are saved in Data Storage resource specified in original request for processing.
37 [2]	WorkingCollection	DataDistribution	prepare_pull_data	Complete staging of subsetted CER03 data objects.
38 [2]	DataDistribution	Desktop	copy_desktop_object_reference	Notify Desktop that requested subsetted CER03 data objects are available.
39 [2]	Desktop	VisualizationApplication		Initiate Visualization Application, with subsetted CER03 data.

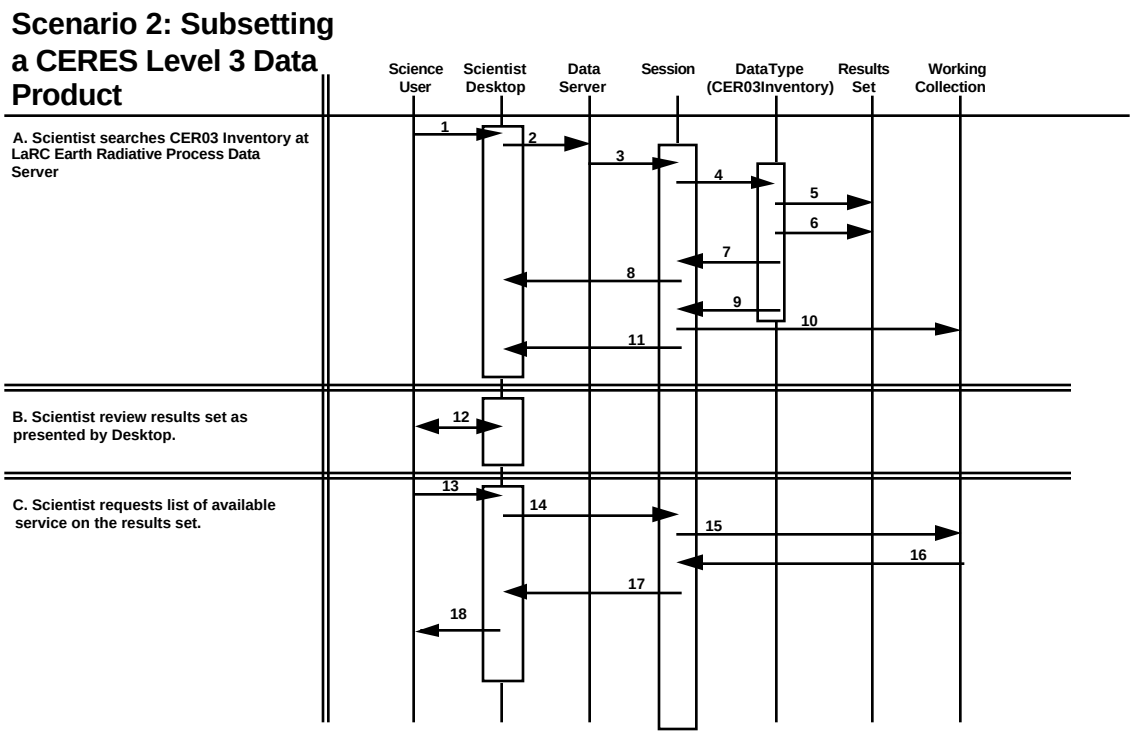

Figure 2.2.1. Subsetting a CERES Level 3 Data Product (1 of 3)

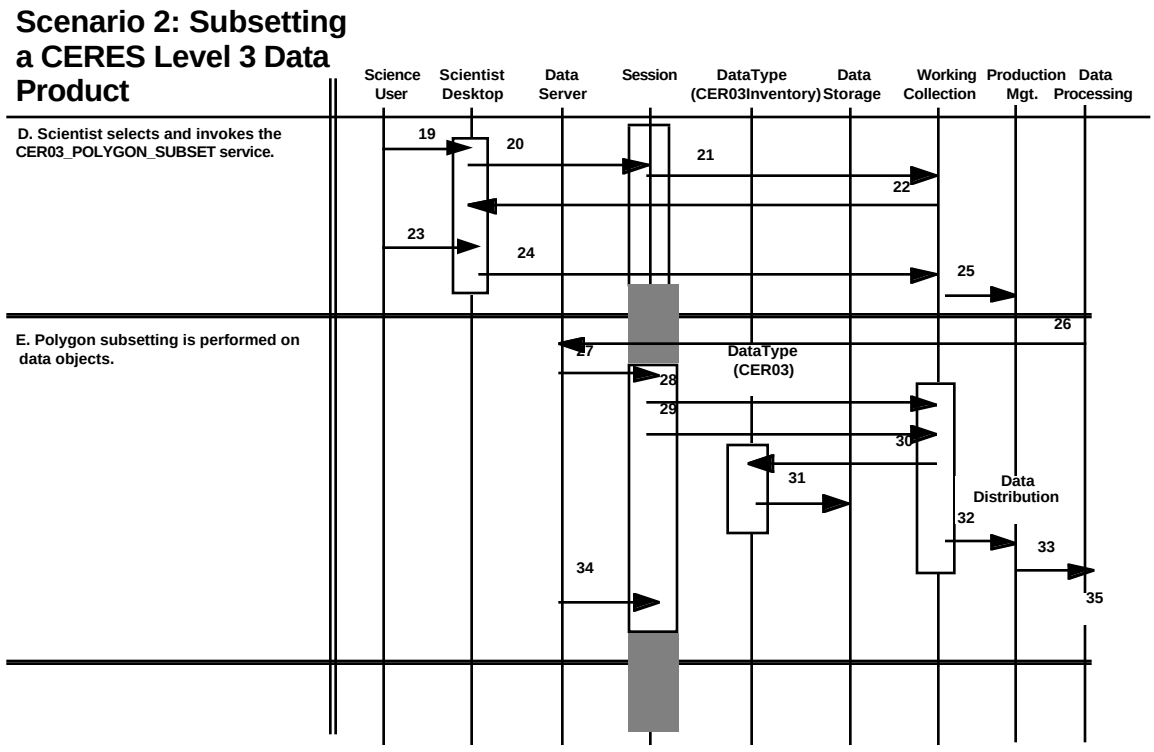

Figure 2.2.2. Subsetting a CERES Level 3 Data Product (2 of 3)

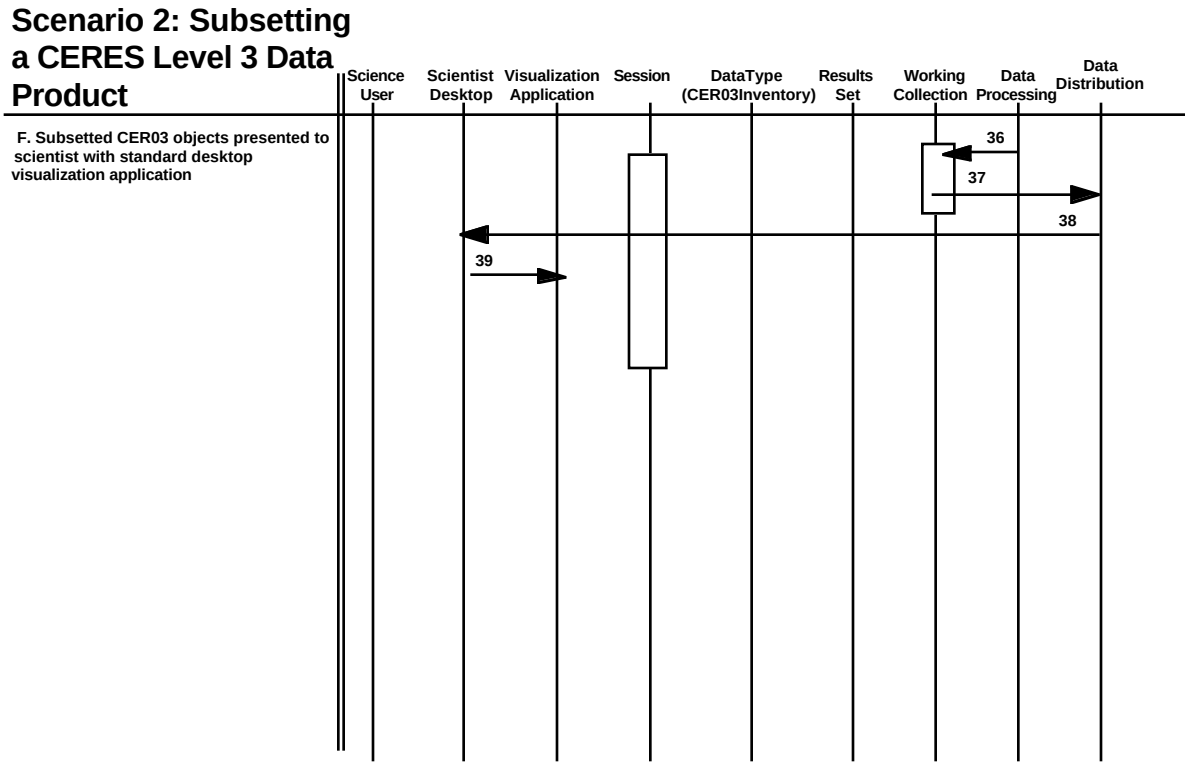

Figure 2.2.3. Subsetting a CERES Level 3 Data Product (3 of 3)

2.3 Dissemination of CERES Instrument Data

2.3.1 Description

This scenario describes the process by which users may request dissemination of data by electronic network or hard media. Dissemination of data is provided via the Acquire service. This service allows the user to request that the specified collection of data objects be delivered to him. The Acquire service allows the user to specify the collection of data desired, the media type that it is to be sent on and which of the available packaging approaches are to be used. Examples of media types are: CD-ROM, 9-track tape, 8mm tape, ExaByte and electronic. The hard media options will vary on a site-by-site basis. There are two types of electronic dissemination, electronic push and electronic pull. Electronic push is the vehicle for a client to request that a collection of data objects be sent to the client's resources. Electronic pull is the vehicle for a client to specify that a collection of data objects be placed on some electronic storage device that is a Data Server resource. After the data is made available on Data Server storage resources, the Data Server notifies the client via email or TBD methods. The client will then "pull" the data into his own domain, most likely via client services that use tools like ftp. The data will eventually be deleted from this Data Server resource based on the policy established at each DAAC.

There are other issues to be concerned with in addressing data dissemination. Clients may want to be able to specify data products that comprise the collection that is to be acquired. Acquire requests are like all other data access requests in that they allow the user to specify the collection to be operated on. The session services provide a mechanism for the user to request dissemination of the working collection (the default), or the client to redefine the collection. This includes of adding data objects to the working collection. If the client desires that other data objects are to be included in the same dissemination request, he adds the object references in the request.

Data collections that are disseminated to clients also will have a set of supporting material to be sent along with the data. At a minimum this will include a label of some sort and a packing list, or its equivalent. Other information that may be sent with disseminated data might include some user manuals. The Data Distribution component will check the materials that are to be sent along with this data type and include them with the data objects. The Data Distribution component will check this list of supporting material for its current version and determine through a product order history if this client has already received the current version of the material. Dictated by local policy, the Data Distribution component may not send out copies of the same supporting material to the same user. Policy might dictate that once a client receives the current version of supporting material it will not be sent again by default.

When an Acquire request is fulfilled, the contents of the "shipment" will be included in some header information about the originating request and the set of data objects included. This local "inventory" of the collection contents will be included in a way that supports the Client services rebuilding a collection from this local "inventory".

In this example the user is requesting Clouds and Earth's Radiant Energy System (CERES) Level 2 data objects be disseminated using an electronic pull (i.e. the resultant data will be placed in a storage location and a notice will be sent to the user when the data is available).

Using services provided by the Interoperability and Data Management Subsystems, the scientist determines that the LaRC Earth Radiative Process data server has the data and services he is interested in. The scientist is provided with an icon representing the inventory search service for this data server. He establishes a collection of Single Satellite Cloud-Radiation Pixel Product (CER04) data objects by using the advertised services of this Data Server. In this case, the scientist has performs a search on the inventory of CERES products, and decides that the CER04 product best reflects the information on cloud cover that is desired. The scientist then has further limited the set of data objects that he is interested in by refining the search criteria in an interactive session. The result of this refinement is a set of CER04 data objects over Hawaii, for November 1998. The scientist has decided that this collection of data objects is the proper one to develop further analysis tools and conduct further analysis with. He decides that the 9GB of data can be stored locally, and decides to Acquire this collection, in HDF, with Electronic Pull.

In this example the CER04 data objects are stored in the archive as compressed HDF files. The scientist's Acquire request for the collection will be fulfilled by the CER04Collection. The specific data objects in the collection will be staged from the proper archive into a working storage area. After the data has been placed on the working storage area in the default compressed HDF format, the Data Distribution component is asked to perform the proper

distribution, in this case an electronic pull. Data Distribution checks history logs and determines that this is the first time that this scientist has received this type of data. A packing list for the appropriate manuals will be printed along with a mailing label. Then a notice will be sent to the operations staff that there is a shipment to be fulfilled. Operations staff will retrieve the proper documentation, package it, include a signed copy of packing list, place the label on it and use the sites mailing service to deliver the package to the scientist. The Data Distribution component will coordinate with Management Application Services to send an email notice to the scientist indicating that the data objects are available and the supporting documents have been mailed.

2.3.2 Relevant Scenario/Step

Scenario #13/Step 17 from the ECS User Model Team Scenario Compilation (March, 1994)

2.3.3 Service Call

CER04::/Acquire/Acquire (collection, packing info, mediatype)

2.3.4 Earth Science Data Type

CER04 Level 2 Single Satellite Cloud-Radiation Pixel Product (CRS)

2.3.5 Data Event Trace Table and Diagram

Table 2.3-1. Dissemination of CERES Instrument Data Event Trace Table (1 of 3)

Step	From	To	Service	Description
1	Science User	Desktop	open_desktop_object	Re-establish scientists connection to the data server inventory search service.
2	Desktop	DataServer	search	Bind search request (Data Location: LaRC Earth Radiative Process data server, Data Type: CER04Inventory).
3	DataServer	Session	initiate_session	Create a session between the client and the ESDT collection.
4	Session	DataType (CER04Inventory)	search	Invoke the search service on the LaRC Earth Radiative Process' CER04 Inventory.
5	DataType (CER04Inventory)	Results Set	create	Establish results set, which will be a collection of CER04 Inventory objects.
6	DataType (CER04Inventory)	Results Set	add_to_collection	Add CER04 inventory objects to results set.
7	DataType (CER04Inventory)	Session	provide_status	Provide updates to "hit count" (number of matching inventory objects).

Table 2.3-1. Dissemination of CERES Instrument Data Event Trace Table (2 of 3)

Step	From	To	Service	Description
8	Session	Desktop	status_update	Provide visibility of "hit count" (number of matching inventory objects) to scientist.
9	DataType (CER04Inventory)	Session	report successful completion	
10	Session	WorkingCollection	create	Create the session's working collection from the results set.
11	Session	Desktop	deep_copy_desktop_object	Provide the search results to the scientists desktop.
12	Science User	Desktop	open_desktop_object	Scientist reviews the search results set
13	Science User	Desktop	search_container	Scientist refines results set (Time:11/98, Geographical location: Hawaii).
14	Desktop	Session	execute_request	Request session execute search service on working collection (Time:11/98, Geographical location: Hawaii).
15	Session	WorkingCollection	search	Command to refine the current working collection.
16	WorkingCollection	Session	provide_status	Provide updates to the "hit count" (number of matching inventory objects).
17	Session	Desktop	status_update	Provide visibility of "hit count" (number of matching inventory objects).
18	WorkingCollection	Session	report successful completion	Return successful completion to session.
19	Session	Desktop	deep_copy_desktop_object	Provide the search results to the scientists desktop.
20	Science User	Desktop	desktop_object_invoke_service	Scientist requests to acquire the working collection via electronic pull with e-mail notification when the request is completed.
21	Desktop	Session	execute_request	Request session to acquire data objects in the working collection.
22	Session	WorkingCollection	acquire	Bind this service to the working collection of CER04 Inventory data objects (Protocol: electronic pull, Notification: email). Returns estimated cost, time, and size information to session.
23	Session	Desktop	status_update	Provide visibility of estimated cost, time, and size information to the scientist. Scientist may cancel request is desired.

Table 2.3-1. Dissemination of CERES Instrument Data Event Trace Table (3 of 3)

24	DataType (CER04)	DataStorage	retrieve	Retrieve data objects from archive and put them in a staging area.
25	WorkingCollection	DataDistribution	prepare_pull_data	Transfer the data objects to a user accessible area. NOTE: It is the user's responsibility to perform the "pull" upon examination of the data. The data will eventually be deleted from this data access area based on policies whether the user has pulled the data or not.
26	DataType (CER04)	DataDistribution	prepare_media	Print documentation for requested data objects.
27	WorkingCollection	DataDistribution	create_media_package	Create mailing labels, packing slip,etc. and notify the operations staff that a shipment is ready to be packaged.
28	DataDistribution	Common_facilities	electronic_mail	Notify the scientist that the requested data objects are available for pickup.

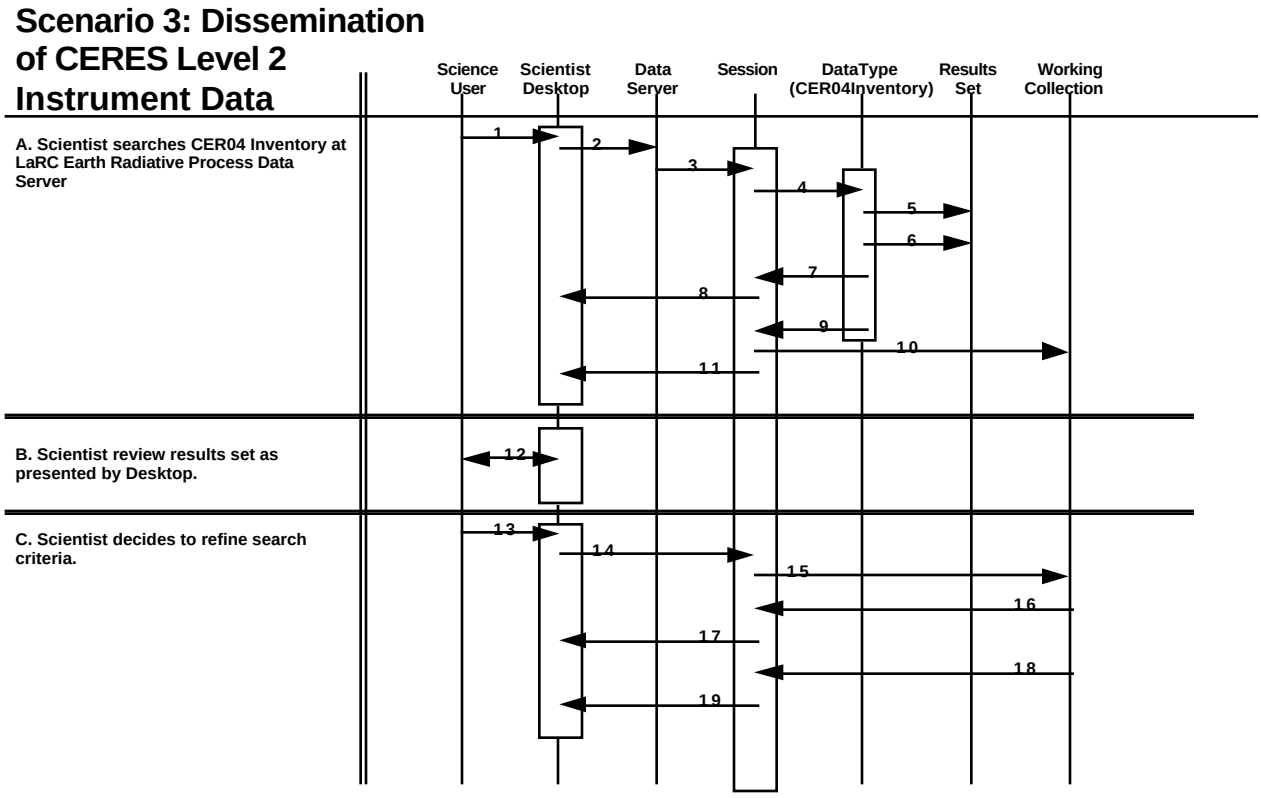

Figure 2.3.1. Dissemination of CERES Level 2 Instrument Data Event Trace Diagram (1 of 2)

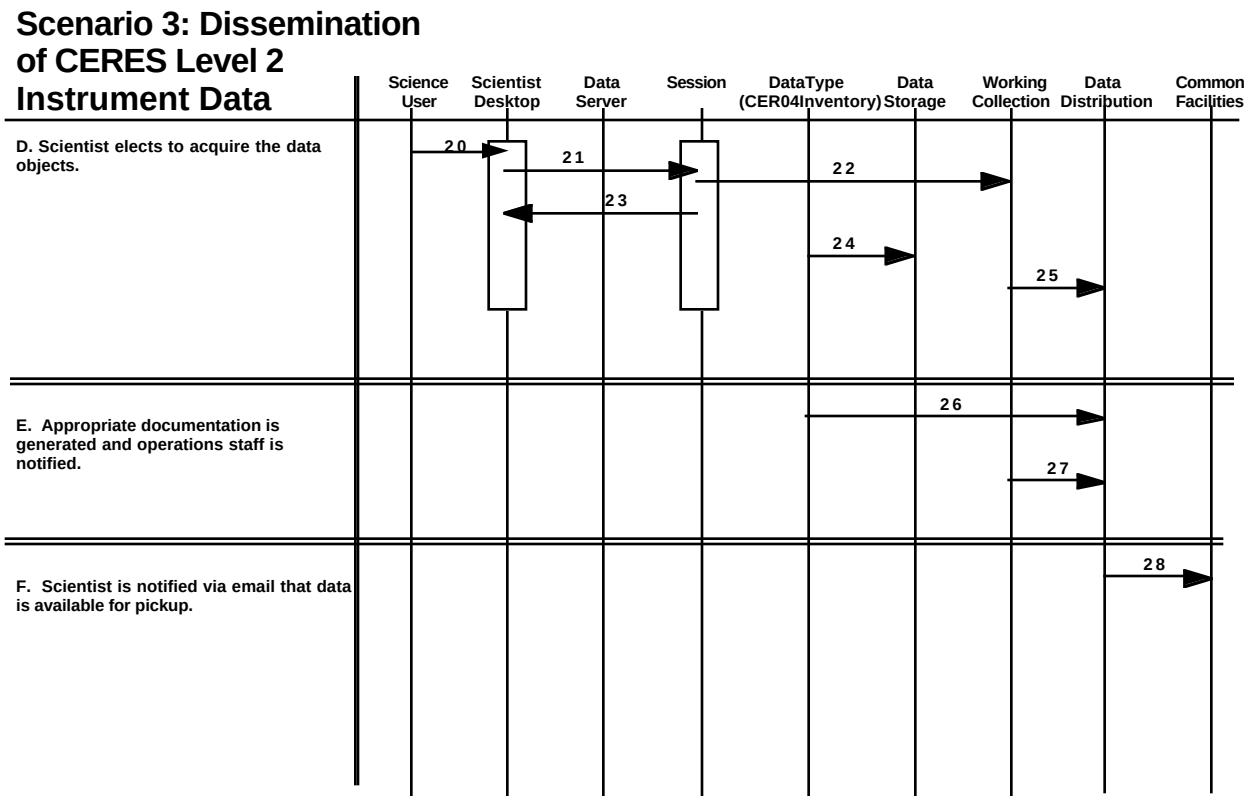

Figure 2.3.2. Dissemination of CERES Level 2 Instrument Data (2 of 2)

2.4 Searching Inventory for ASTER Instrument Data

2.4.1 Description

Inventory services provide scientists with the capability to locate the data that they are interested in. Inventory services are a search-type of service. This scenario describes the process by which users search for Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) data objects. The Search service allows the user to specify query parameters that will be applied to the current inventory in order to refine the set of data objects that they are interested in. The collection of data objects that is the result set from the Search request will be either sent to the client or made available to the client, via session services. In this example, the user is searching for AST11 - Normalized Difference Vegetation Index (NDVI) images. For the AST11Inventory valid parameters on an inventory search are spatial, time, and quality parameters. Users will supply the query parameters with the search request. For any parameters not specified defaults will be used. It is important to note that AST11 data objects are not to be processed routinely, but on demand. In supporting this on demand processing the AST11 inventory will still fulfill the search request in the same manner as any other inventory search request from the user's

perspective. However, the inventory itself will be implemented using different techniques.

There are three identified options for implementing the inventory of on-demand products (also referred to as virtual inventory): a false inventory, a "not" inventory or a mathematical inventory. In the false inventory, when the Level 1 data used to produce the Level 2 AST11 product is created by the Data Production facility, an inventory entry for the AST11 product will also be created, but with no actual data. The Data Server will update the AST11 inventory with this false entry. Upon receipt of a request to acquire this false inventory data, the AST11 inventory will create the AST11 data object. This creation will be accomplished by collaborating with Data Production Planning to generate the product. The "not" inventory strategy will simply store inventory entries for products that it cannot provide and the inventory collection will behave as though the products are available. Upon request for products, items on the "not" list will not be created. Other products will be generated as in the false inventory case. The third approach to inventory of on-demand products is the mathematical inventory. In this strategy the inventory will determine if a product is available based on the user provided search parameters. The inventory will use these parameters, namely time/space parameters, in a mathematical equation to determine if the product can be created. For the AST11 on demand product the inventory will be the false inventory.[4]

In this example, through the support of the Interoperability and Data Management Subsystems the scientist has determined that the Land Surface Vegetation Data Server at EDC is the proper provider for the AST11 data (Normalized Difference Vegetation Index [NDVI]) that they are looking for. The scientist has an icon on his desktop representing the inventory search service for this data server. The scientist initiates this service to interactively form search requests. In this scenario the scientist is interested in AST11 data objects for the past 15 years over Sahelian Africa (5 degrees N to 15 degrees N x 17 degrees W to 40 degrees E). The request will be verified by the Data Server and a session will be established with the scientist. Then the search will be performed on AST11 Inventory data objects within the specified search criteria. The AST11 Inventory returns results to the session that are saved as a working collection. The session provides this results set to the scientist's desktop for review.

If the scientist requests further services of a specific set of the presented AST11 data objects, the data server, as a provider, would communicate some estimate of the time, size, and cost to actually acquire that product for confirmation, before the actual product is generated. If the scientist requests the product, processing continues as in section 2.6.

2.4.2 Relevant Scenario/Step

Scenario #9b (Undergraduate Student Research Topic in Remote Sensing)

2.4.3 Service Call

ASTER::/Search/Search(collection, query)

---

[4] This is an assumption for the purpose of illustration. As further analysis is performed, the specific implementation method for the AST11 inventory will be determined.

2.4.4 Earth Science Data Type

AST11 Normalized Difference Vegetation Index (NDVI)

2.4.5 Data Event Trace Table and Diagram

Table 2.4-1. Searching Inventory for ASTER Instrument Data Event Trace Table

Step	From	To	Service	Description
1	Science User	Desktop	open_desktop_object	Re-establish the scientists connection to the data server inventory search service. In re-establishing the search interface, the search interface will be re-configured with current parameters, valid values, etc.
2	Desktop	Data Server	search	Bind search request (Data Location: EDC Land Surface Vegetation data server, Data type:AST11Inventory, Temporal Coverage: 15 years, Spatial: 5°N to 15°N x 17° W to 40° E).
3	Data Server	Session	initiate_session	Create a session between the client and the data server.
4	Session	Data Type (AST11Inventory)	search	Invoke the search service on the EDC Land Surface Vegetation data server.
5	Data Type (AST11Inventory)	Results Set	create	Establish the results set, which will be a collection of AST11 inventory objects. Note: In this example, the associated data objects do not actually exist.
6	Data Type (AST11Inventory)	Results Set	add_to_collection	Add AST11 inventory objects to results set, as they match search filter criteria.
7	Data Type (AST11Inventory)	Session	provide_status	Provide updates to "hit count" (number of matching inventory objects).
8	Session	Desktop	status_update	Provide visibility of "hit count" (number of matching inventory objects) to scientist.
9	Data Type (AST11Inventory)	Session	report successful completion	
10	Session	WorkingCollection	create	Create the session's working collection from the results set.
11	Session	Desktop	deep_copy_desktop_ object	Provide the search results to the scientists desktop.

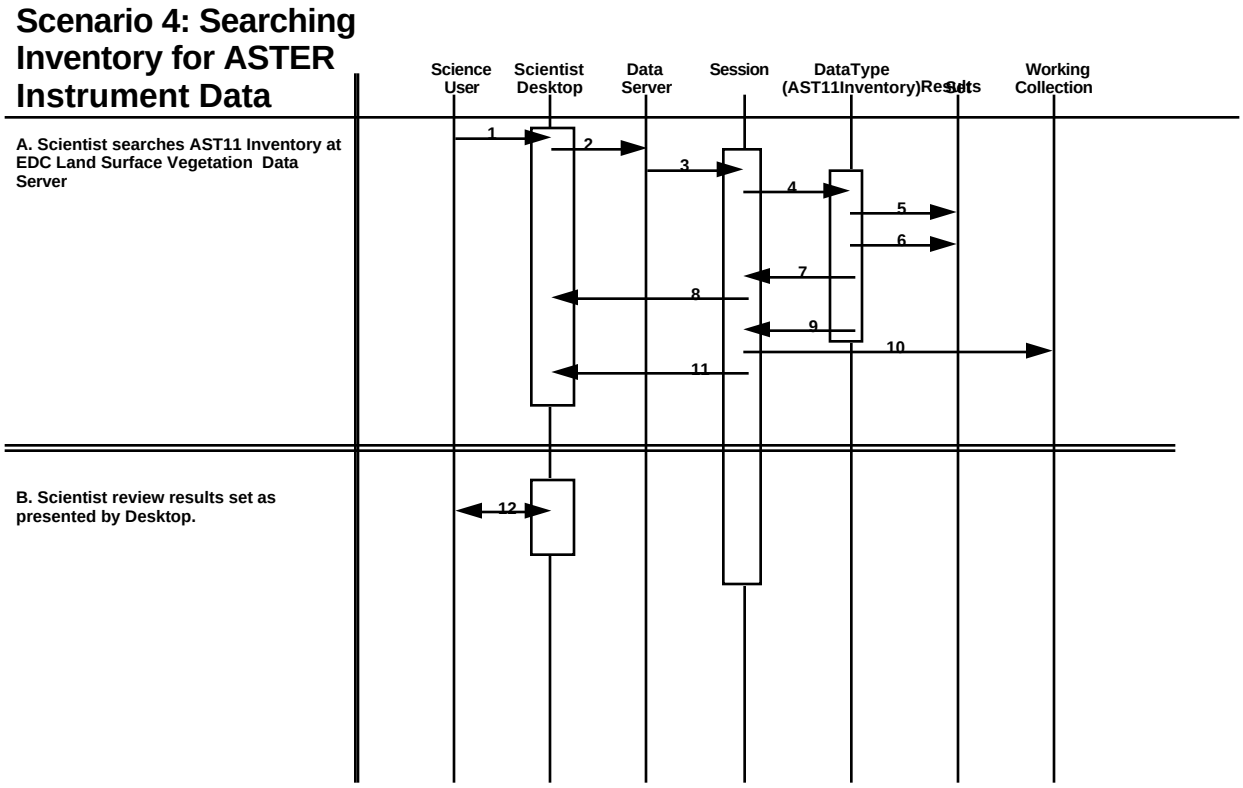

Figure 2.4.1. Searching Inventory for ASTER Instrument Data Event Trace Diagram

2.5 Browse of ASTER Image Data

2.5.1 Description

The inspect services provide the user with the capability to examine a reduced volume of data on a granule basis to assist in identifying data of interest. This reduced data or browse product includes image as well as non-image information dependent upon the needs of the scientist and the characteristics of the data.

The user establishes a collection of data objects of interest by performing searches and queries using the appropriate data type search services. Prior to requesting the inspect service, the user may choose some subset of the collection. After the user requests the inspect service, the Data Server determines how large the results will be and how long it will take to complete the request and provides this information to the user. The user may withdraw the request if desired. Otherwise, the user is asked to provide instructions on the delivery mechanism of the resulting data. This includes whether the data is sent to the user's workstation for browsing locally or the data remains in the Data Server for browsing remotely. Browsing locally has the advantage of speed if the user is performing basic image manipulation such as pan and zoom. Whereas,

browsing remotely might be preferable if the user is using complex image processing and filtering. Any browse products that are not in the archive need to be generated. The user will be asked to supply any parameters needed during the browse product generation, such as desired resolution of the browse product. At any point during this process the user has the ability to withdraw/cancel the request.

A collection of browse products is the result of performing the inspect service on the working collection. This allows visualization of individual images a frame at a time. In addition, this supports the ability to present movie-loops and to overlay multiple frames on a single projection. These visualization techniques would be in the scientist's workbench. The inspect service provides any additional information needed to support the various visualization capabilities such as image resolution, frame of reference, basic metadata, and ancillary data.

This section presents the inspect service for a collection of ASTER Level 2 data products. In this example, data type search services have been previously used to search for ASTER Registered radiance at sensor (AST03) data objects that include Missouri during 1993. This resulted in a collection of 35 objects. The user further refined his collection by eliminating data objects that have a high percentage of cloud cover or a low data quality assessment.

In the current scenario, the user selects the remaining 5 objects and clicks the right mouse button. A list of available services for this data collection is provided. This list includes the option to browse Scene Classification (AST10) or Decorrelation stretch (AST06). The user chooses Scene Classification which describes each scene imaged by ASTER in terms of eight scene classes: cloud, haze, cirrus, snow and ice water, vegetation, soil and rock, and shadow. He is provided with the AST10Browse specific interface which he uses to define the parameters for his request. The user may optionally choose to subset or subsample this data, but the default is the full-resolution image. When the user is satisfied with the parameters and options he has chosen, he submits the request. The AST10Browse interface displays an estimate of the size, the cost, and the time required to obtain the requested data objects and asks the user to confirm his request.

Because AST10 is produced routinely, all of the desired images exist in the archive. The browse service determines that the size of the requested data is 40 MB where each image and header information is approximately 8MB. In this case, the user has a 10 Mbps Ethernet connection. Assuming actual capacity of 10% of that speed due to overhead, packet retransmission, and network load, the transfer will take less than six minutes for the five images. The user has indicated that the collection of browse data should be sent via ftp to his local workstation. The browse data includes the image as well as an image header detailing scene center latitude and longitude, the date and time of acquisition, and summary information. The inspect services send the data, so that the user may use collection-based browsing services installed on his desktop.

2.5.2 User Model Relevant Scenario/Step

Scenario #10/ Step 3 (Land Surface Hydrologic Modeling)

2.5.3 Service Call

AST03::/Inspect/Inspect(collection)

2.5.4 Earth Science Data Type

AST03 Level 2 ASTER Registered radiance at sensor

2.5.5 Data Event Trace Table and Diagram

Table 2.5-1. Browse of ASTER Image Data Event Trace Table (1 of 2)

Step	From	To	Service	Description
1	Science User	Desktop	desktop_object_bind_new_service	User selects to browse Scene Classification data objects.
2	Desktop	Session	execute_request (AST10_BROWSE_INTERFACE)	Desktop requests to browse Scene Classification.
3	Session	WorkingCollection	AST10_BROWSE_INTERFACE	Command to invoke this browse interface.
4	WorkingCollection	Desktop (service interface application)	bind_import_service	Remotely display this browse interface.
5	Science User	Desktop (service interface application)		User manipulates this interface to submit requests for AST10 browse products associated with the working collection. This interface also provides optional subsetting and subsampling capabilities.
6	Desktop (service interface application)	WorkingCollection	AST10_BROWSE	Using the service interface, the user submits the request which invokes the associated browse service.[5]
7	WorkingCollection	DataType (AST03Inventory)	inspect	Retrieve the associated browse products from storage.
8	DataType (AST03Inventory)	DataType (AST10)	create	Instantiate AST10 browse objects for the associated AST03 objects.
9	DataType (AST10)	DataStorage	retrieve	Retrieve AST10 browse data objects from the associated archive.
10	WorkingCollection	Session	provide_status	Provide status related to the progress of the browse retrieval.
11	Session	Desktop (service interface application)	status_update	Provide visibility of retrieval progress.
12	WorkingCollection	DataDistribution	push_data	Command to electronically push the data to the user's resources.

[5] The WorkingCollection interacts with the service interface application to provide information about the estimated cost, size, and time required to transfer the requested objects and to obtain confirmation from the user to proceed with the request.

Table 2.5-1. Browse of ASTER Image Data Event Trace Table (2 of 2)

Step	From	To	Service	Description
13	DataDistribution	Common_facilities	file_access	Transfer the files to the user's resources (Protocol: ftp).
14	WorkingCollection	Session	provide_status	Provide status related to the completion of browse retrieval.
15	Session	Desktop (service interface application)	status_update	Provide visibility of browse completion information including completion status, cost, size, and elapsed time to transfer the data.

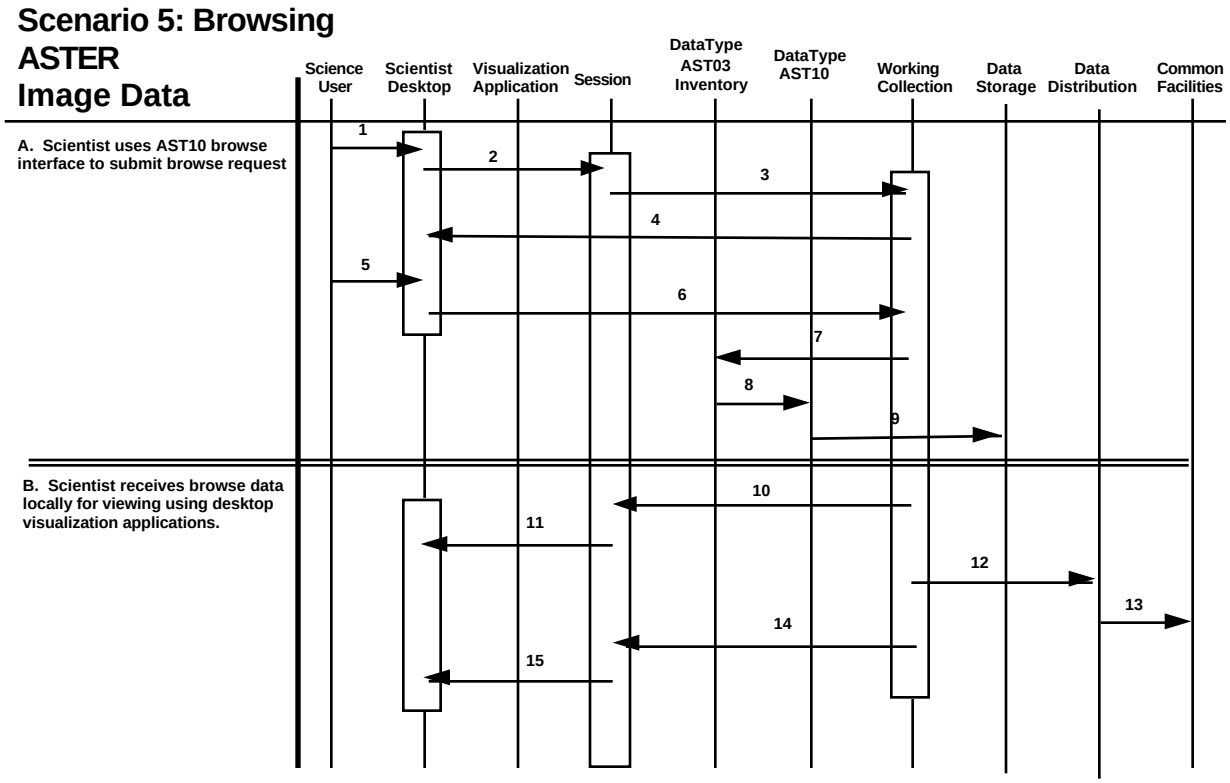

Figure 2.5.1. Browsing ASTER Image Data Event Trace Diagram

2.6 On-demand Execute ASTER Level 2 Data Product

2.6.1 Description

ECS users see services of products, whether the data objects themselves are available or not. On-demand execute occurs when access to a data object service is requested, yet that data object does not yet exist in the data server. Data servers will offer services that are needed to support users science analysis, yet for space and/or performance reasons the actual data objects that will provide those services may not be automatically generated. This on-demand service is a Produce-type of service where the system will generate new (higher level) data products from currently archived data products. Users will have the ability to specify not only the algorithm to be used to generate the data product, but they also have the ability to select the version of the algorithm to apply. Depending on the product selected for execution, it may or may not be stored into the archive when generated. DAAC policy will dictate whether a data object is stored or not. If the newly generated data object is to be archived, then any associated inventory, browse, or dictionary information will be generated and archived as well.

This section presents the on-demand execute service for an ASTER data object. This example presents the actions required to generate the Brightness Temperature at Sensor (AST04) data product from the Level 1B Registered Radiance at Sensor (AST03) data product that is currently stored in the archive. AST04 is currently scheduled to be produced only for thermal infrared (TIR) spectral range data. TIR spectral range channel data is used to study evapotranspiration, and land and ocean temperatures. At the Earth Radiative Process Data Server at EDC, when AST03 data objects are generated inventory entries are for corresponding AST04 data objects are also generated. However the actual AST04 products themselves are not generated. Instead, as AST04 data objects are generated by user request, the data server will retain them, thereby only investing processing resources in AST04 data objects that have proven to be of interest.

A user logs on and submits an inventory request for AST04 data products and defines a rectangle containing the United States and specifies the afternoon of December 14, 1999. This produces a list of twelve inventory items to select. This list also denotes which data items are currently stored in the archive, as oppose to those that would require generation. The user proceeds by selecting three of the items. The user submits a request to acquire, via electronic pull, AST04 data for all three selected items. The user, via the acquire service interface, specifies the dissemination parameters, as well as the algorithm parameters. Since one of the images is currently stored in the archive, the Data Server proceeds to retrieve the data product from the archive and prepare it for distribution to the user. The user will receive acknowledgment and an universal reference containing the location of the data when it is ready to be pulled into the user space.

The other two images are not currently stored in the archive, and therefore will have to be generated. Each image will be generated in collaboration with the Data Processing subsystem. As a default, the most current version of the Brightness_Temperature_Algorithm will be used. The parameters are collected and Data Planning is notified of the Produce request. Upon receipt that the data was generated by Data Processing, the user's request is fulfilled by having Data

Distribution make the newly generated AST04 data objects available to the user. Based on DAAC policies, the data server stores the newly generated data into the archive.

2.6.2 User Model Relevant Scenario/Step

Scenario #19/Step 9 (Biogeochemical fluxes at the Ocean/Atmosphere Interface)

2.6.3 Service Call

AST03::/Produce/Brightness_Temperature_Algorithm (version, spatial_coverage, temporal_coverage)

2.6.4 Earth Science Data Type

AST03 Level 1B Registered Radiance at Sensor

AST04 Level 2 Brightness Temperature at Sensor

2.6.5 Data Event Trace Table and Diagram

Table 2.6-1. On-demand Execute ASTER Level 2 Data Product Event Trace Table (1 of 4)

Step	From	To	Service	Description
1[6]	Science User	Desktop	open_desktop_object	Re-establish the scientists connection to the data server inventory search service.
2[6]	Desktop	Data Server	search	Bind search request (Data Location: EDC Earth Radiative Process data server, Data type:AST04Inventory, Spatial: rectangle defining United States) .
3[6]	Data Server	Session	initiate_session	Create a session between the client and the data server.
4[6]	Session	Data Type (AST04Inventory)	search	Invoke the search service on the EDC Earth Radiative Process's AST04Inventory. (Spatial: rectangle defining United States).

[6] This step is performed in the data server's direct support of the scientist's request (as the data server's client).

Table 2.6-1. On-demand Execute ASTER Level 2 Data Product Event Trace Table (2 of 4)

Step	From	To	Service	Description
5[6]	Data Type (AST04Inventory)	Results Set	create	Establish the results set, which will be a collection of AST04 inventory objects.
6[6]	Data Type (AST04Inventory)	Results Set	add_to_collection	Add AST04 inventory objects to results set, as they match search filter criteria.
7[6]	Data Type (AST04Inventory)	Session	provide_status	Provide updates to "hit count" (number of matching inventory objects).
8[6]	Session	Desktop	status_update	Provide visibility of "hit count" (number of matching inventory objects) to scientist.
9[6]	Data Type (AST04Inventory)	Session	report successful completion	
10[6]	Session	WorkingCollection	create	Create the session's working collection from the results set.
11[6]	Session	Desktop	deep_copy_desktop_object	Provide the search results to the scientists desktop.
12[6]	Science User	Desktop	open_desktop_object	Scientist reviews the search results set.
13[6]	Science User	Desktop	desktop_object_invoke_service	Scientist subselects 3 specific data products of interest from the list to acquire. Then the acquire service is requested.
14[6]	Desktop	Session	execute_request	Desktop requests AST04_ACQUIRE interface.
15[6]	Session	WorkingCollection	AST04_ACQUIRE_INTERFACE	Command to invoke AST04_ACQUIRE interface. Also redefines working collection contents to the subselected elements.
16[6]	WorkingCollection	Desktop (service interface application)	bind_import_service	Remotely display AST04_ACQUIRE interface on desktop.
17[6]	Science User	Desktop (service interface application)		User manipulates the AST04_ACQUIRE interface, defining the algorithm version, parameters and dissemination parameters.

Table 2.6-1. On-demand Execute ASTER Level 2 Data Product Event Trace Table (3 of 4)

Step	From	To	Service	Description
18[6]	Desktop (service interface application)	WorkingCollection	AST04_ACQUIRE	Interface results sent to working collection
19[6]	WorkingCollection	DataType (AST04)	acquire	Request to acquire available data object.
20[6]	DataType (AST04)	DataStorage (archive)	retrieve	Retrieve data objects from archive, placing them into the "pull" staging resource.
21[6]	WorkingCollection	DataDistribution	prepare_pull_data	Complete staging of AST04 data objects.
22[6]	DataDistribution	Desktop	copy_desktop_object_reference	Notify Desktop that first requested AST04 data object is available.
23[6]	WorkingCollection	Production Management	Submit_Process_Request	Request correct algorithm be performed with user specified criteria in order to generate the two AST04 data objects. Session then is waiting for request to be fulfilled.
24[7]	Data Processing	Data Server	acquire	Request for staging of objects needed to generate the two AST04 data objects. Location is a Data Processing storage resource.
25[7]	Data Server	Session	initiate_session	Create a session between the client (Data Processing) and the data server.
26[7]	Session	WorkingCollection	create	Create the Data Processing client session's working collection from the information provided by Data Processing.
27[7]	Session	WorkingCollection	acquire	Bind request to acquire the objects specified. The request is to have the objects staged on a disk resource that the Data Production (this session's client) has specified (an electronic push).

[7] This step is performed in the data server's direct support of the Data Processing subsystem request. The Data Processing subsystem's requests are indirectly supporting the scientists for generation of AST04 data objects.

Table 2.6-1. On-demand Execute ASTER Level 2 Data Product Event Trace Table (4 of 4)

Step	From	To	Service	Description
28[7]	WorkingCollection	DataType (AST03)	acquire	Request to acquire each specified data object.
29[7]	DataType (AST03)	DataStorage (archive)	retrieve	Retrieve data objects from archive, placing them into the "push" staging resource.
30[7]	WorkingCollection	DataDistribution	prepare_push_data	Complete staging of needed objects for data processing.
31[7]	DataDistribution	DataProcessing		Data Availability Notice sent to Data Processing.
32[7]	DataServer	Session	terminate	Data Server terminates session, which cleans up resources used and removes it as an active session.
33	DataProcessing		executes algorithm	Actual generation of AST04 data objects is performed within the Data Processing Subsystem.
34[6]	DataProcessing	WorkingCollection	report successful completion	Data Processing completes generation of AST04 data objects. Results are saved in Data Storage resource specified in original request for processing.
35[6]	WorkingCollection	DataType (AST04)	create	Actually create the AST04 data objects.
36[6]	DataType (AST04)	DataStorage (archive)	store	Insert new AST04 data objects in the permanent archive.
37[6]	DataType (AST04)	DataType (AST04Inventory)	add_to_collection	Add new AST04 objects to inventory.
38[6]	WorkingCollection	DataDistribution	prepare_pull_data	Complete staging of newly generated AST04 data objects for client.
39[6]	DataDistribution	Desktop	copy_desktop_object_reference	Notify Desktop that requested AST04 data objects are available.

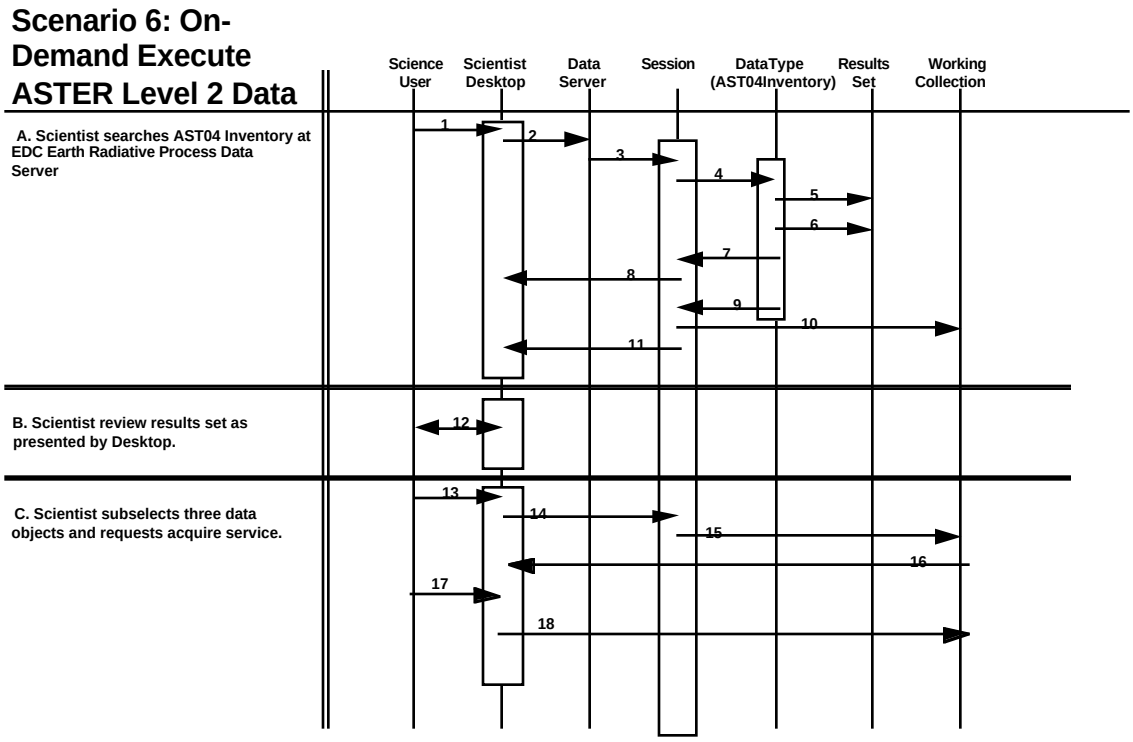

Figure 2.6.1. On-Demand Execute of ASTER Level 2 Data Product (1 of 3)

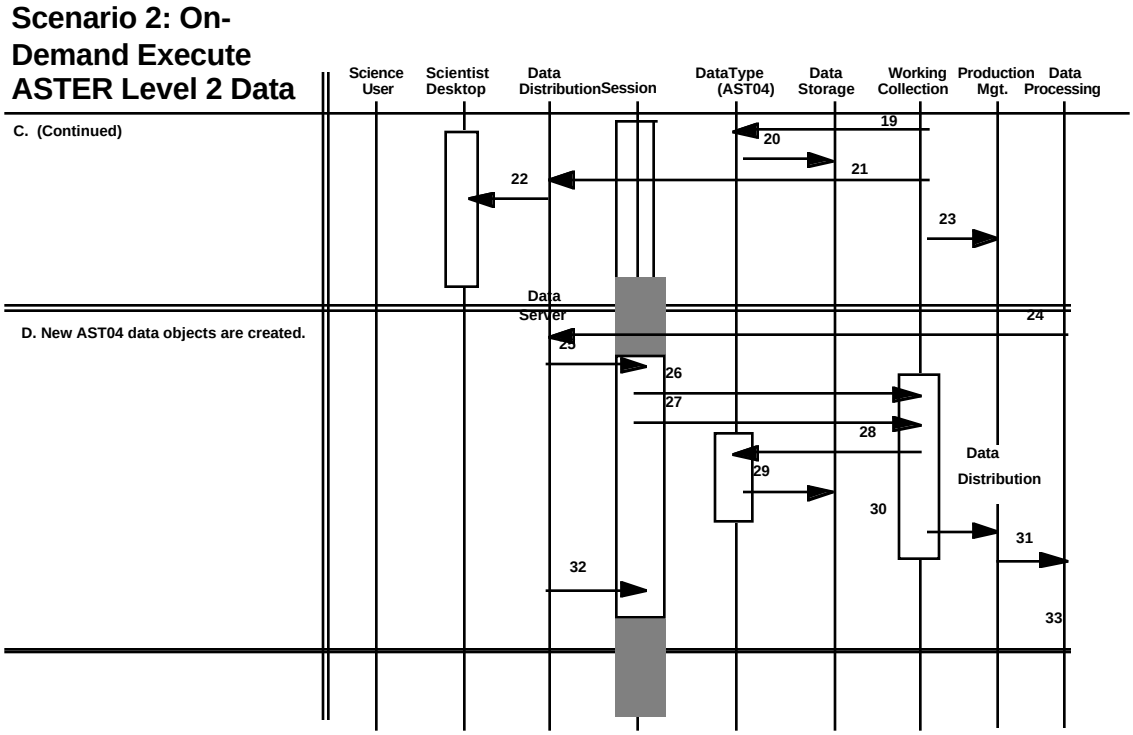

Figure 2.6.2. On-Demand Execute ASTER Level 2 Data Product (2 of 3)

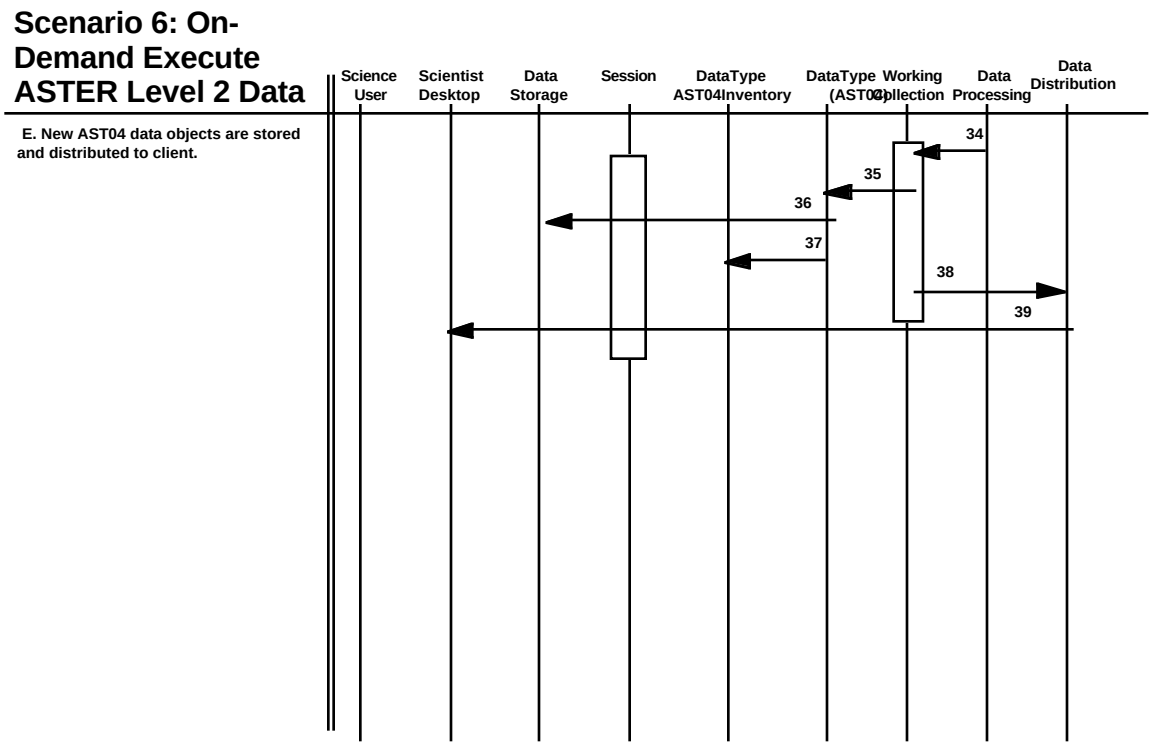

Figure 2.6.3. On-Demand Execute ASTER Level 2 Data Product (3 of 3)

2.7 Inserting In-Situ Data

2.7.1 Description

This service provides the ability to insert in-situ data objects into a data servers holdings. In-situ data is non-satellite data which may be collected using ships, buoys, balloons, etc. This data is used by scientists to correlate and validate satellite data. ECS will archive this data and make it available to the user community, but provide only limited services such as search and acquire. However, the DAACs may provide additional services to support the unique needs of their user communities.

The Data Server collaborates with an ingest client to insert new data objects. There is an ingest client for each data type. Each ingest client requests the insert service of the appropriate data server to insert data objects. The insert service uses the create service of the given data type. The create service determines which DataStorage object contains this data type and requests the store service of that object. After the data is stored, inventory data objects are created for each new granule. The create service for the inventory data object determines which DataStorage object contains this data type and subsequently requests the store service of that object. The ingest client is then notified that the ingest has completed.

This section presents the insert service for radiosonde in-situ data which is collected from about 130 stations operated by the U.S. weather services and cooperating countries. This data includes upper air temperature, humidity, dew point, wind direction and speed, and height of pressure levels above mean sea level that are obtained from radiosondes (radio transmitters carried by balloons). In general, radiosonde observations are done twice a day although some stations have taken from one to four or more observations per day. Twice daily, the National Meteorological Center (NMC) combines the data from all stations for an observation into a single file, generates associated metadata such as data quality and observation date, and sends the file to ECS. The ingest subsystem receives the radiosonde data, verifies that the data size is correct, and produces additional metadata such as date and time received. The radiosonde in-situ ingest client requests the insert service of the Atmospheric Dynamics Data Server and provides the data and associated metadata. The create service for the radiosonde data type stores this information using point data computer science data type in the AMASS HSM DataStorage object[8]. Then, the inventory for this data type is populated with an entry for the granule including the universal reference, date and time received, date and time of observation, data size, geographical zone, and data quality.

ECS provides insert, create, and acquire services for the radiosonde data as well as a service to search for granules based on information in the inventory for that data type. The LaRC DAAC has determined that its user community would like to be able to search and acquire radiosonde data based on station, time and location. LaRC could develop unique services to augment ECS provided services for this data type. Assuming that the data files will still be stored as a single granule, LaRC could develop unique create and acquire services for this data. The create service would extract station identifier and time for each observation and populate the inventory with a record for each station/observation combination all referencing the same granule. The new acquire service could extract data from the granule based on the station identifier. If LaRC determines that it would be more efficient to separate the data into multiple granules based on station and time, then only a DAAC specific create service would be needed.

2.7.2 Relevant Scenario/Step

User Model Scenario 22b/ Step 1A (Climate, Erosion, and Tectonics in the Andes and other Mountain Systems)

2.7.3 Service Call

Radiosonde::/Insert/Insert(data_location)

2.7.4 Earth Science Data Type

Radiosonde Observations, NMC in-situ data

---

[8]This is an assumption for the purpose of illustration. As further analysis is performed, the specific mechanism for storing this data type will be determined.

2.7.5 Data Event Trace Table and Diagram

Table 2.7-1. Inserting In-Situ Data Event Trace Table

Step	From	To	Service	Description
1	DataProvider (NMC)	Ingest_Client	startup	Initiate the Radiosonde Insitu data Ingest Client. This may be initiated automatically based on a schedule or manually by an authorized user.
2	Ingest_Client	DataSource	ingest	Transfer data from the buffer, verify the data was successfully transferred, and notify data provider of data transfer completion.
3	Ingest_Client	DataServer	insert	Request insert of radiosonde in-situ data objects into the archive.
4	DataServer	Session	initiate_session	Create a session between the ingest client and the data server.
5	Session	DataType (Radiosonde)	create	Instantiate radiosonde data objects as point data. This creation may involve the execution of a science algorithm or user method.
6	DataType (Radiosonde)	DataStorage	store	Request that the DataStorage object that holds in-situ radiosonde data objects store the data objects. Any other associated information, such as the algorithm used to develop the data, is stored as well.
7	DataType (Radiosonde)	DataType (Radiosonde_Inventory)	create	Instantiate new inventory record for this data type for each newly inserted in-situ radiosonde data objects.
8	DataType (Radiosonde_Inventory)	DataStorage	store	Request that the DataStorage object that holds in-situ radiosonde inventory data objects store the data objects.
9	DataType (Radiosonde)	Session	provide_status	Provide status of the insert request.
10	Session	Ingest_Client	ingest_log	Add to the historical record of data ingested.
11	Ingest_Client	Session	terminate_session	Terminate the session.

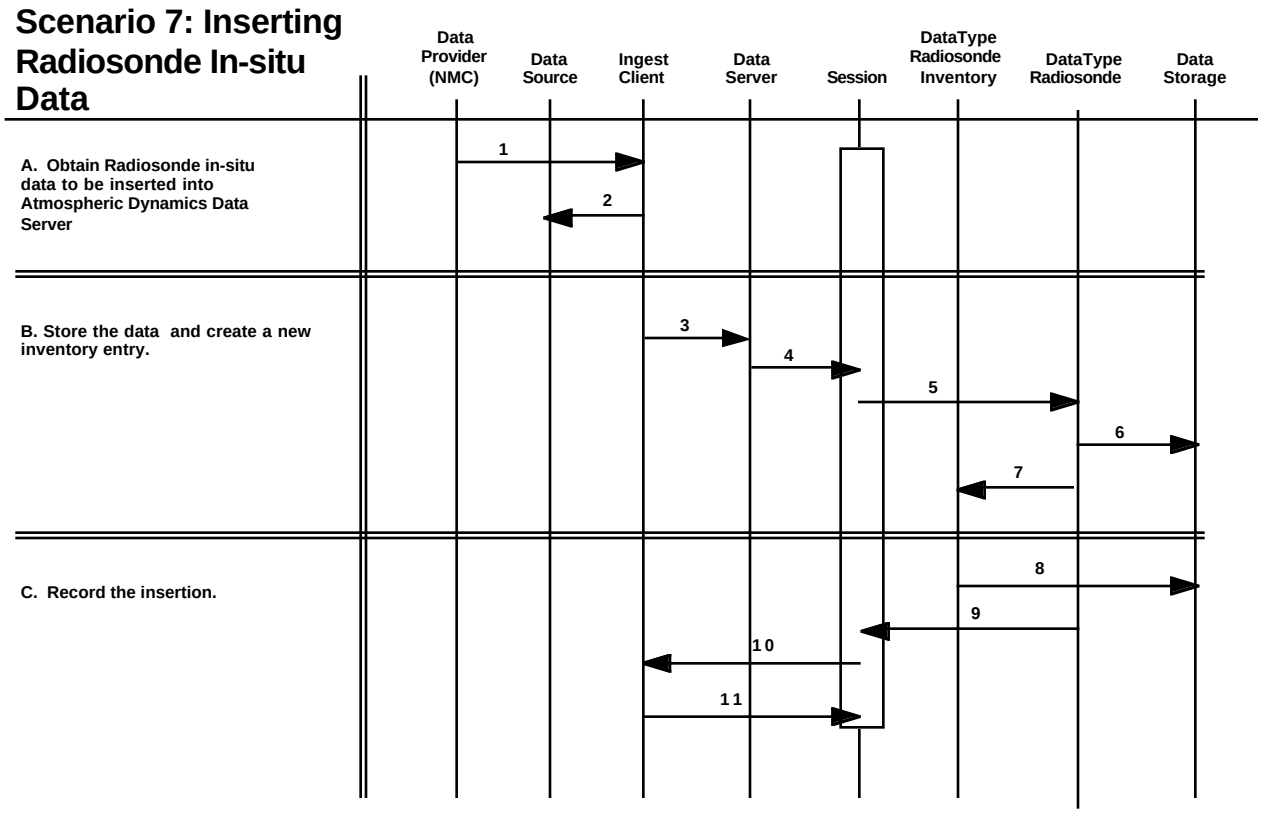

Figure 2.7.1. Inserting Radiosonde In-situ Data Event Trace Diagram

This page intentionally left blank.

Abbreviations and Acronyms

ASTER	Advanced Spaceborne Thermal Emission and Reflection Radiometer
CERES	Clouds and Earth's Radiant Energy System
CSDT	Computer Science Data Type
ECS	EOSDIS Core System
EOSDIS	Earth Observing System Data and Information System
ESDT	Earth Science Data Type
NMC	National Meteorological Center
SDPS	Science Data Processing Segment